EECS 861
Random Signals and Noise

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Course Information

• Semester: Fall 2023
• Lecture: Room 1136 Lea; time 9:30 -11:45 PM TR
• Discussion: Room 1136 Lea; time 5:00-6:50 PM Monday will be used for test reviews, make up classes, and as needed homework reviews. **Will not meet every week; check web if discussion session is meeting.**
• Text: “Random Signals: Detection, Estimation and Data Analysis” by Shanmugan and Breiphol.
• Alternate Texts:
  – Probability and Random Processes, A. Leon-Garcia
  – Probability, Random Variables and Stochastic Processes, Papoulis and Pillai
Course Information

• Class Web Page:
  http://www.ittc.ku.edu/~frost/EECS_861/index_EECS_861_Fall_2023.htm

• Office hours and Contact Information:
  – 2054 Eaton Hall-- 8:00 - 9:00 & 1:00 - 2:00 T & R
  – Other times by appointment
    (Likely in the office MWF afternoons, e-mail me to confirm my availability)
  – Phone: 785 864 1028
  – e-mail: vsfrost@ku.edu (best way to contact me)
  – Final: Tuesday, December 12

<table>
<thead>
<tr>
<th>Class Meeting Schedule</th>
<th>Tuesday, December 12 Final Exam Schedule</th>
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<tr>
<td>9:30 TR</td>
<td>7:30 – 10:00 a.m.</td>
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Course deliverables

• Exams: 2 in class tests (open book & notes)
• Final (open book & notes)
• Homework: problems will be assigned & graded.
• Grading:
  – 2 - In class tests; open book & notes = 40%
    (20%/test)
  – Homework & Unannounced Quizzes = 20 %
  – Class participation & attendance = 10 pts
  – Final = 30%
• General guidelines: Only under very extreme conditions will make up tests be given. No late homework will be accepted
Initial Grading Scale

- 90 - 100 % A
- 80 - 89 % B
- 70 - 79 % C
- 60 - 69 % D
- 0 - 59 % F

Lower limit on these ranges maybe reduced as a function of the distribution of the final scores.
This course (EECS 861) will not utilize +/- grading in Fall 2023.

Homework

- All homework assignments will be posted on the class web page
- Solution will not be posted, any problem will be worked in class or during office hours upon request.
- Homework is to be submitted on paper at the beginning of the class period.
- Electronic submission of assignments is not permitted.
Homework Format

• All work containing more than one page must be stapled - no paper clips and no folded corners. In order to facilitate grading of homework problems, homework shall meet the following specifications:

1. Hand written or typed single-sided on 8.5” x 11” paper.
2. If not typed then for text and equations, use an HB or No. 2 pencil (or darker), or blue or black ink. (Pencil is preferred.) No other colors please, except in diagrams or graphs.
3. All pages should be numbered i/j in top right hand corner, with your name appearing at the top of each page. It is O.K. to use your initials after the first page.
4. All work must be shown for full grade - be as thorough as possible.
5. Writing should be legible and literate - if the grader cannot read your handwriting, you will receive no credit for the problem.

Homework Format

• 6. Answers are to be boxed and right justified, with the variables, values (if any) and units (if any), included in the box. Right justified means placed on the right side of the page.

7. Leave half an inch between consecutive parts of a question, and draw a line across the page at the end of each complete question.
8. No part of a question should appear in any margin of the paper.
9. Diagrams and graphs should be of a good size (say at least 3x5 sq. inch), and may contain colors. Diagrams and graphs must be titled, labeled, and clearly drawn. Tables should also be titled.
10. Graphs should be scaled (put number on axes), labeled (put names /units on axes), and titled at the bottom of the graph. Any graph which is not titled will not be graded. Where possible use conventional units such as bits/sec, Hertz and km.

   Graphs and plots should be done with a plotting tool.
Tools Used for Class Assignments

- Some homework assignments will require plotting, you can use Matlab or another software tool for your choice.
  - MatLab
    - For plotting in MatLab see Plotting Functions using fplot
      https://www.youtube.com/watch?v=Xaos1ALuNCg
    - Creating stem plots in MatLab https://www.youtube.com/watch?v=bWizuYwwAbk
  - Excel
  - WolframAlpha https://www.wolframalpha.com/
  - Any other plotting tool is acceptable, e.g., see Graphing Function
    https://mathstat.slu.edu/~may/ExcelCalculus/sec-1-4-
    GraphingFunctionsExcel.html
  - and Online Graph Plotter
    https://www.transum.org/Maths/Activity/Graph/Desmos.asp
  - The demos plotter https://www.desmos.com/calculator

- Wolfram CDF Player
  - Interactive documents
  - Installed on all EECS Windows computers

- Some homework assignments will require processing of .xls or .csv ("comma-separated values") files. You can use any tool for homework, e.g., matlab, excel, C, java, C++, other.
Class Attendance and Participation

• Enrolling for this class signifies that the students plan to participate in all of lectures and exams. Each student is responsible for knowing any information delivered in every class.

• Academic success in this class requires:
  – regular class attendance
  – doing the homework
  – and class participation.

Course Outline

(Sections subject to change)

• Probability (Chapter 2)
  – Axioms
  – Random Variables
    • Discrete
    • Continuous
  – Distributions
    • Marginal
    • Joint
    • Conditional
  – Expect Value
  – Characteristic and moment generating functions*
  – Random vectors and Multivariate Gaussian RVs*
  – Transformations of RVs
  – Bounds and Approximations*

• Random Processes (Chapter 3)
  – Definition
  – Example RPs
  – Stationarity
  – Autocorrelation function
  – Power Spectral Density
  – Ergodicity
  – Decomposition of RPs
  – Major classes of RP
    (Sections 5.2, 5.3, 5.4.1-5.4.2, 5.5)

* Possible new topics
Course Outline

- Response of Systems to Random Inputs
  (Sections 4.1, 4.2 4.3.1-4.3.3)
  - Discrete time systems
  - Continuous time systems

- Application of Random Process Theory
  - Detection (Chapter 6)
  - Estimation
    (Sections 7.1, 7.2, 7.7, 8.4.1, 8.4.2, 8.4.5, 8.4.6, 8.4.7, 8.5.1)

Use of EdTech Services
- Professors and instructors at the KU School of Engineering are aware that some students are actively posting homework, laboratory, and exam questions and responses to EdTech services (e.g., Chegg) even during exam time frames.
- Keep in mind that when a person signs up to participate by either uploading, and/or downloading, and/or using posted material from these sites, the “terms of service” that are agreed to do not protect the person when KU and/or the School of Engineering decide to conduct investigations related to academic misconduct (e.g., plagiarism and/or cheating).
- In fact, EdTech services, like Chegg, retain contact information of students who use their services and will release that information, which is traceable, upon request. Using these services constitutes academic misconduct, which is not tolerated in the School of Engineering. It violates Article 3r, Section 6 of its Rules & Regulations, and may lead to grades of F in compromised course(s), transcript citations of academic misconduct, and expulsion from the University of Kansas.
- If unsure about assignments, it is important that students use the allowable available resources, such as instructor office hours, graduate teaching assistants, and/or tutoring. The School of Engineering wants students to be successful; cheating is not the way to attain that success.
Use of smartphones, tablets, and laptops in class.

- Smartphones, tablets, and laptops may only be used in direct support of class activities.

- Texting, general web browsing, checking of e-mail is NOT permitted during class.

- Video and audio recording of the EECS 861 class lectures is prohibited.

Changes announced in class and the class web site supersede these written instructions.

Student with disabilities or special needs should arrange to see me for accommodations.